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CONTENTS

The Committee on Inter-American Scientific Publication: *Harlow Shapley* 603

Robert Ridgway's Color Standards: *D. H. Hamly* 605

Technical Papers

The Genetic Effects of Low Intensity Irradiation: *Delta E. Uphoff* and *Curt Stern* 609

An Electrical Logic Machine: *Benjamin Burack* 610

The Application of Soy Bean Inhibitor in Tissue Cultivation: *Albert Fischer* 611

Occurrence of Vitamin B_c Conjugase in Human Plasma: *R. Wolff, L. Drouet,* and *R. Karlin* 612

The Effects of Choline and Methionine on Phospholipide Formation in Patients with Liver Disease as Measured by Radioactive Phosphorus: *David Cayer* and *W. E. Cornatzer* 613

Evidence for the Conversion of Carbon Monoxide to Carbon Dioxide by the Intact Animal: *Robert T. Clark, J. Newell Stannard,* and *Wallace O. Fenn* 615

Comments and Communications

Color Standards for Biologists 617

Scientific Book Register 617

News and Notes 618

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The Committee on Inter-American Scientific Publication

Harlow Shapley, *Harvard University*

A DIRECT REPORTING SERVICE to all the 1,323 Peruvian physicians; the building up of a mathematical library in the City of Mexico; the processing and placing of 92 articles in technical and scientific journals of the United States; the compiling of a Latin American *Men of Science*—these are among the activities of a small committee that has been working for eight years in the interests of promoting both the international spirit of science and inter-American cooperation. Other activities include providing surveys of scientific developments in the United States, written by experts in the various fields, for publication in one or more of the many scientific journals of the other American republics; and working with half a dozen of the leading scientific societies of the United States in the preparation of monthly or bimonthly summaries of progress that are put at the disposal of Latin American editors.

The Committee on Inter-American Scientific Publication was started in September, 1941, under the auspices of the Coordinator of Inter-American Affairs. The plan was orginated by members of the faculty of the Massachusetts Institute of Technology and Manuel Sandoval Vallarta directed its activities for the first year. Since that time the committee has been under my chairmanship and its headquarters have been at the Harvard Observatory until very recently, when larger space became available at the American Academy of Arts and Sciences, 28 Newbury Street, Boston. From the beginning, Christina Buechner has been executive secretary.

The other committee members at the present time are: Roger Adams, chairman, Department of Chemistry, University of Illinois; Bart J. Bok, associate director, Harvard College Observatory, and chairman, National Research Council Committee on Unesco; Robert J. Caldwell, formerly minister to Bolivia, later dean of humanities, Massachusetts Institute of Technology and at present, cultural relations attaché, United States Embassy, Buenos Aires; Watson Davis, director, Science Service; James R. Killian, Jr., president, Massachusetts Institute of Technology; James H. Means, chief of medical services, Massachusetts General Hospital; and Franz Schrader, chairman, Department of Zoology, Columbia University.

A year ago the National Research Council and the American Association for the Advancement of Science agreed to provide joint sponsorship of the Inter-American Committee. They set up a joint advisory committee composed of: F. R. Moulton, formerly administrative secretary of the AAAS; E. C. Stakman, professor of plant pathology, University of Minnesota, and president of the AAAS; and R. L. Zwemer, executive secretary of the National Research Council.

If we judge by the wholehearted cooperation the committee receives from the scientists and scientific institutions of all the Latin American countries, we must grant that the project is meeting an important need in the promotion of One World of Science.

Our initial activity was directed to obtaining for the scientists of the other American republics a wider scientific audience for their technical contributions. Publication in Europe had been interrupted by the war and most North American scientists, unfamiliar with the Spanish and Portuguese languages, were unaware of the work of their southern colleagues. The Inter-American Committee asked Latin American scientists to submit technical papers that merited a wider attention than was provided by their national journals. An article sent to the committee, sometimes after screening by Latin American advisors, was translated, edited appropriately, and submitted, always on its own merits, to the editor of the most suitable journal in the United States.

This initial enterprise has been highly satisfactory. From its small budget the committee was able to pay for translation and a limited number of reprints, and to meet other minor expenses. Once good relations had been established between American scientific editors and Latin American contributions, our liaison work was completed. We had expected this particular function to decrease in importance, but we still receive many communications that need our intermediary assistance.

To date, 161 scientific articles have been sent to us from the south—from Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Guatemala, Mexico, Peru, Uruguay, and Venezuela. About 70 percent of the submitted manuscripts have been accepted by editors in the United States, for publication in the following journals: *American Heart Journal; American Journal of Hygiene; American Journal of Mathematics; American Journal of Pathology; American Journal of Physiology; American Journal of Roentgenology and Radium Therapy; American Journal of Tropical Medicine; American Mathematical Monthly; Archives*

of Pathology; Astronomical Journal; Astrophysical Journal; Biometrics Bulletin; Blood—Journal of Hematology; Cancer Research; Duke Mathematical Journal; Endocrinology; Gastroenterology; Genetics; Journal of the American Chemical Society; Journal of the American Pharmaceutical Association; Journal of Applied Physics; Journal of Bacteriology; Journal of Biological Chemistry; Journal of Chemical Education; Journal of Chemical Physics; Journal of Clinical Endocrinology; Journal of Mathematics and Physics; Journal of Nervous and Mental Diseases; Journal of Neurophysiology; Journal of Organic Chemistry; Journal of Pharmacology and Experimental Therapeutics; Physical Review; Physiological Reviews; Proceedings of the Society of Experimental Biology and Medicine; Science; Surgery, Gynecology, and Obstetrics; and *Transactions of the American Mathematical Society.*

From the beginning we had hoped to make our work a two-way project. We felt that we should not only receive papers from Latin America, but that our scientists should contribute to publications in the various American republics. We have succeeded in carrying out this plan, again with surprising success. Three of the operations should be briefly described.

After considerable investigation, including a visit of the executive secretary to most of the universities and scientific institutions of Latin America, we discovered the rather unexpected fact that there are in existence more than 1,200 scientific publications in the Latin American countries. We found that the editors of many of the most important journals would like to use articles from North America, and especially to use those contributions that would help keep the scientists of the various countries in step with the rapid developments in the United States. One of the best ways to keep up with a subject is to get experts to write summaries of progress and problems in specific fields. We asked some leading American scientists if they would not send to us, for transmission to the most suitable Latin American journals, articles of 2,000 to 3,000 words. (Incidentally, we accompanied our request with the information that the small funds available would permit a payment of $50 to cover wear and tear on nerves and secretaries.)

Our solicitation of special surveys and summarizing articles has produced many original contributions. Of the 88 that have already been received, or are being prepared, I shall list only the first five papers received: "Human Biology of the Greeks," by J. Laurence Angel; "Modern Trends in the Tropical Meteorology of the Americans," by Robert D. Fletcher; "Some Recent Advances in Chemical Kinetics," by George W. Beadle; "Concerning Aging," by William deB. MacNider; and "Enzyme Kinetics and the Dynamics of Their Behavior," by Hudson Hoagland.

The submitted contributions are translated into the appropriate language by the journal editors. The articles have been so well received that some American editors have suggested that we put their journals on our list. One series of papers on architecture and home planning merits special mention. It was beautifully printed, with many illustrations by *Nuestra Arquitectura* in Argentina; the seven general American contributors were Charles Abrams, Henry S. Churchill, Jacob Crane, G. Holmes Perkins, José Luis Sert, Christopher Tunnard, and Catherine Bauer Wurster.

A second service from American scientists to Latin American colleagues is provided by the American scientific societies, which have arranged to send through the committee, for distribution to hundreds of scientific journals in Latin America, short and generally not too technical notes on current developments. We are greatly indebted to the societies, and especially to those who have compiled these periodical news items, for their liberal cooperation. The first summaries came from the American Chemical Society, the American Pharmaceutical Association, the American Medical Association, and the Geological Society of America. The editors receiving these various current science notes are permitted to use them with or without credit to the relevant society in the United States or to our committee. Naturally, the summaries are widely used.

I have already mentioned one of the special services—sending a monthly article, on some specific disease or medical subject, to the doctors in Peru. Three distinguished Peruvian physicians, Telemaco Battistini, Alberto Hurtado, and Carlos Alberto Seguin, have formed a committee to sponsor a special series prepared by American doctors and medical scientists. These articles are translated, published, and distributed to all practising physicians of the country. The first was by I. Forest Huddelson on the subject of human brucellosis (undulant fever) and the second by Chester S. Keefer on penicillin. Twenty of these up-to-date articles have already been published or are on their way. Needless to say, this assistance to the doctors and citizens of Peru is warmly appreciated. There are also direct and indirect benefits to the medical science of the United States. In tropical medicine, as well as in many other fields, we can learn much from our South American colleagues.

The work with the Peruvian medical scientists was greatly assisted through the personal interest of Ernest B. Howard, formerly associated with the Divi-

sion of Health and Sanitation of the Institute of Inter-American Affairs and now assistant secretary of the American Medical Association. We find that our activities can often be coordinated with that of other organizations, to our mutual benefit. It is quite possible that the medical work for Peru can be extended to other Latin American countries. Progress is being made toward setting up other collaborative groups in Latin America which should promote not only interchange with our committee, but also useful interchanges among the scientists of the different Latin American countries.

There will probably be opportunities for important cooperation with Unesco's operations in the United States. Mrs. Buechner has worked with the Pan American Union in forming a guide and description of the various universities, colleges, and scientific institutions of the American Republics. The Inter-American Committee has also been closely associated with the large translation project managed by *Science Service,* and is thus in close contact with the scientific publishing houses of Latin America.

Finally, I should mention that the existence of the Inter-American Committee has become so well known in Latin American scientific circles that the office in Boston has the opportunity of undertaking a multitude of miscellaneous services. They include bibliographic work, guiding Latin American students and scholars in their travels through the United States, entertaining scientific visitors, and some assistance to the many science students in the Boston area (including the annual "Evening with the Stars" at the Harvard Observatory). To handle these miscellaneous operations competently, we shall soon require a larger budget and a larger staff.

The gratifying cooperation given our committee has led us to propose that the Committee on Inter-American Scientific Publication should become an International Committee on Scientific Information. From 34 countries of Europe and Asia we have received requests for the special articles by experts, for the summaries prepared by the scientific societies, and for other services of the sort we now give in the interests of our Latin American assignment. The cultural attachés connected with our embassies and legations in a number of countries in the Eastern Hemisphere have already distributed copies of our material. So far as it goes, this distribution from government offices in Europe and Asia is useful; but we feel that it would be better to deal directly with the scientists, and with their scientific journals and institutions.

Robert Ridgway's Color Standards

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PRIOR TO THE APPEARANCE of Ridgway's *Color standards and color nomenclature* in 1912 (*22*) English-speaking biologists had neither a standardized set of colors nor a generally recognized set of color names. Scientists had long been striving for accurate description but had not felt the specific need for precise color terminology until about 200 years ago, when the many naturalists interested in the mass of new material brought in by world explorers had to introduce order into their descriptions if the information they recorded was to be of any value to others. In two of the first important systematic works written in English, especial care was taken in respect to color records, both in the written descriptions and in the coloring of the copper plate engravings. Mark Catesby, writing in 1743 (*1*), says: "In Designing the Plants I did them fresh and just gathered; and the Animals, particularly the birds, I painted them alive (except a very few . . .)." He concludes by referring to possible color variability of two kinds: pigment changes in his illustrations and actual color differences in specimens arising from seasonal variations. George Edwards reported his methods of drawing, engraving, and coloring in the preface to *A natural history of birds* (*4*). He states: "A copy carefully and exactly coloured from the original drawings will be deposited in the Library of the College of Physicians, of London, which may serve as a Standard to refer to and to compare with, to try the Truth of the Colouring, in case the Plates should outlive me, and any should question the Authority of the Colouring." He adds, in Part II in 1747, "This book hath the Advantage to be Original in its Figures, as well as its Descriptions; not one of the former being copied from others, or the latter being translated or transcribed."

Many of the color records made since the develop-

ment of modern systematics by Linnaeus, both in the early period and today, are very similar to those made by an early Canadian naturalist, Charles Fothergill (*7*), who in 1820 described the back of a sandpiper as "a light olivaceous yellow brown, or dead flesh color." Workers in color have been irritated by such terms, even though admitting that they are superior to imaginative descriptions such as "Elephant's breath" and "Isabella-colored," and have preferred to use descriptions such as olive, scarlet, and turquoise, or color words such as red, pink, and brown, modified in various ways as recommended by Judd and Kelly (*12*).

Color terms of any sort, however, cannot be used satisfactorily without reference standards, and standards cannot be used over any extended period of time unless they are reproducible. While standards of sorts have existed for many years, the three most widely used in the English-speaking world today are those that satisfy, in part at least, the color theories advanced within the last 100 years by Clerk Maxwell, Hermann von Helmholtz, and others. These three systems have much in common, but they differ considerably in some respects, and each possesses some unique attribute. The one devised by Albert H. Munsell (*16, 17*), a professor of normal school art, has qualities that give it fundamental importance when judged by modern physical and psychological standards. One introduced by Wilhelm Ostwald (*5, 20*), a great physical chemist, finds many applications in the field of decoration. The standards developed by Robert Ridgway are preferred by biologists. There are two apparent reasons for this preference: most of the colors needed by biologists are included, and most of the names assigned to the colors are satisfactorily descriptive according to everyday usage. Besides the frequent references to these standards in biological writings, there are also many uses in other fields which indicate their status. Dade (*3*) standardizes Saccardo's Latin Color Names (*24*) on a Ridgway basis; Maerz and Paul (*14*) make many references to Ridgway names and give their color equivalents; and Wilson (*26*), in his color charts for horticultural use, gives Ridgway names for his chips when possible, as does Villalobos (*25*) in a recently published set of standards.

Robert Ridgway (1850–1929) was curator of birds at the United States National Museum for over fifty years, and "was known and honored throughout the ornithological world," to quote an obituary (*27*). While he was an active student of bird life for some seventy years, and writing on the subject much of that time, as the dates of his 540 papers indicate (*9*), his contributions to the science of color are noteworthy also, because of his paintings and two books on color standards. Very early in his life he started painting portraits of birds, and they had become so good by the time he was ten years old that his schoolmates are said to have paid as much as fifteen cents each for them (*2*). Besides being interested in good illustrations, he became involved in the problems of color description in the taxonomy of birds and he saw the need for reference standards not only in ornithology, but also in the whole field of biology.

He attempted to satisfy this need by publishing in 1886 *A nomenclature of colors for naturalists* (*21*), illustrated with 200 hand-stenciled chips, and supplied with a glossary of parallel color name equivalents in seven languages. He justified the publishing of the book by writing: "The want of a nomenclature of colors adapted particularly to the use of naturalists has been more or less of an obstacle to the study of Nature," and he also elaborated on the fact that "popular and even technical natural history demands a nomenclature which shall fix a standard for the numerous hues, tints, and shades which are currently adopted, and form part of the language of descriptive natural history" (*21*).

This book was welcomed by contemporary naturalists and its standards are still occasionally used, but Ridgway himself apparently realized its limitations, for he continued to work on color standards and devoted all his spare time for twenty-five years (*9*) to their development and publication. He was encouraged and helped toward this objective by others, two in particular: professionally and financially by his great friend, Don José Zeladón, the famous Costa Rican ornithologist (*23*); and in the handling of details of publication and checking by his wife, Julia Evelyn Perkins Ridgway. *Color standards and color nomenclature,* with its 1,115 named colors, was finally published early in 1913 under the date of 1912, and is still the color system most generally used by biologists.

Ridgway set up his standards with the expectation that they would be exactly reproducible in the future, using methods and materials specified by P. G. Nutting of the National Bureau of Standards, but these are not adequate according to present conceptions of color accuracy. In 1912, standards and methods for the physical specification of visual colors were not yet available. Since then, exact methods have become available, have been accepted on the international level (*12*), and now are coming into general use. It is unfortunate that Ridgway chose some pigments which fluoresce (*8*) and are affected by humidity, by abrasion, by offsetting, and by hue shift (*10*). In addition, his arrangement of colors is such that it is impossible to specify exactly the colors falling between the 1,115 illustrated. This limitation is important,

for it is currently accepted that over ten million shades of color are discernible to the normal observer (*12, 19*). Despite these serious handicaps, the Ridgway standards are still the favorite of biologists, and it is proposed to consider critically the advantages possessed by these standards and not by others.

Ridgway, like Munsell and Ostwald, developed his system of color description after extended study of color phenomena and ideas. It would appear that there were three stages in its development: first, a period of observation and record, in which he considered colors occurring in nature, pigments suitable for recording these colors, and names useful in describing them; second, organizing the colors within the color solid so that the final colors of his system were systematically spaced, with much use of the Maxwell color wheel; and third, reproducing the colors for publication.

The colors are disposed within a color solid on a series of concentric cones that are spread out on the chart as if they were cylinders. Around the mid-periphery of the outer cylinder are distributed the 36 highly saturated colors of his "pure spectrum scale." Above each color are the three "tints," obtained by systematic dilution with white, and below are the "shades" obtained by dilution with black. Thus there are seven colors for each hue in the series. The first cylinder of colors lying within the outermost is known as the "prime one" (′) series. The full colors on the mid-periphery of this cylinder are derived from the full colors of the outer spectrum series by dilution with a definite percentage of neutral gray, the tints by dilution with the same percentage of white as employed in diluting the first series, and the shades in a similar manner by dilution with black. Four additional series of colors, designated as prime two (″), three (‴), four (⁗), and five (⁗′), are derived like the prime one series by addition of increasing amounts of neutral gray. For the central axis of his solid, Ridgway provided two series of grays, called Neutral Gray and Carbon Gray, to be used according to varying conditions.

As the system was planned, there should have been 1,512 colors ($36 \times 7 \times 6$), but Ridgway reduced the number of hues in the series of low saturation, (the reduction being from 36 to 7 in the prime five series, for example) so that the total is only 1,115, consisting of 1,057 regular colors, 42 extra colors, 14 grays, black, and white.

These 1,115 colors were primarily found by using the Maxwell color wheel, and were duplicated by painting. In making up the color chips for publication, enough sheets of paper were painted of each color to provide for an edition of 5,000 copies (*8*). The work was done by A. Hoen and Company of Baltimore, initially under the immediate direction of Ridgway and his wife. While troubles and accidents hampered them from the beginning (*9, 18*), the original painted sheets were sufficient for most of the required chips. Though further editions were contemplated, only one was issued. Some confusion on this point has been caused by a letter written in 1937 which has been interpreted as meaning that a second edition had been published (*13*). It had reference only to the completion of the edition.

It has already been noted that Ridgway was very early interested in satisfactory names for colors. From 1885 until 1912 he devoted considerable time to choosing suitable names for his colors from those currently used, and to modifying color names in simple ways to describe related colors. While "Isabella-colored" and "Invisible Green" occur in his nomenclature, there are remarkably few names not suggestively descriptive. In general, the Ridgway names are so good that they have been adopted widely, and it is likely that these names will be applied for a long time to colors similar in appearance to those that he named. He provided, in addition to the names, a system of notation. This is not very generally used, but it is the only method for identifying the 4,559 in-between colors, recognized in the system but not provided with names or chips.

Biologists are sometimes asked by color workers why they prefer the Ridgway standards. This question has been answered by a mycologist: "I can find the colors I want there, other mycologists use the same standards, and the literature for years has employed Ridgway names." Mass use by biologists is indicated by similar statements from other specialists, and also by the replies to the Canadian Questionnaire (*15*). It would thus seem probable that Ridgway standards would continue to be used for many years to come if they were permanent, and if new copies could be obtained, regardless of the scientific advantages of other methods of color description.

Answers to the Canadian Questionnaire and many personal discussions have clearly indicated that other color systems have been considered and used. Many biologists have tried and have flatly rejected the *Munsell book of color* as unsuitable for biological work. In developing his key to Ridgway in terms of Munsell notations (*8*) the author became interested in this point of view, which seems to be caused primarily by the lack of matchable colors. After work on the key was finished the notations of the Ridgway colors were examined to see if there was a foundation for this opinion. It was found that of the 1,057 regular Ridgway colors, 454 are outside the range of the 40-hue *Munsell book of color*: 221 are higher in value and/or chroma; 136 found in 18 hues possess a lower chroma;

and 97 are marginal. The number of low chroma colors is noteworthy, for they are especially useful in ornithology, mammalogy, and mycology. The need for low chroma Munsell colors has now been recognized by publication of special colors for soil work.

The future of the Ridgway standards and the Ridgway appraisal of color needs. In summarizing the present status of the Ridgway standards and their place in future color description there are two main considerations. The first is that there is no means of reproducing the original colors exactly and it is possible to give only approximate equivalents, as has been done in other systems and in the author's key now being published. The second is that experience has shown biologists generally are satisfied by the selection of colors that Ridgway worked so long and successfully to fit to their needs.

In view of these facts biologists might well consider the adoption of a comparably inclusive but permanent system of color description. While such a system might be entirely new, it could be much more readily developed, and would make available a very large body of information and past experience, if it were standardized primarily on the international basis provided by I.C.I. agreements of 1931 (*11*). It could be fitted into the Munsell color solid, so that there would be no need for an entirely new set of standards, but only a series of specialized sets of color corresponding to those parts of the Ridgway colors that have been most widely used in the various special fields. If this were done at an early date, aid could be obtained from active users of Ridgway and it would not be necessary to depend upon records in the literature and a key, both of which have distinct limitations, chiefly because of actual physical changes in the various copies of Ridgway standards.

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TECHNICAL PAPERS

The Genetic Effects of Low Intensity Irradiation[1]

Delta E. Uphoff and Curt Stern

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It has been shown by Spencer and Stern (*3*) that irradiation by X-rays at high intensity induces mutations in sperm of *Drosophila melanogaster* at dosages as low as 50 r and 25 r, and that the proportionality between r dose and mutation frequency is maintained down to these low dosages. Earlier workers had established independence of induced mutation frequency from the intensity of irradiation at high and medium dosages. In contrast to these findings, Caspari and Stern (*1*) obtained no significant difference in mutation rates between controls and experimentals, which had been subjected to a dose of 52.5 r in gamma rays administered continuously for 21 days at a rate of 2.5 r per day.

This unexpected result required further tests. After consideration of various factors the following were regarded as possible causes for the apparent inactivity of irradiation in the experiment by Caspari and Stern: (1) low sensitivity to irradiation of aged sperm, (2) dependence of induced mutation frequency at low dosages on a time factor, and (3) errors of sampling which might have obscured a true difference between control and experimental rates. The first possibility was studied by administering 50 r in gamma rays continuously over 24 hr to sperm which had been aged previously for 20 days in the spermathecae of females (*4*). In this experiment the intensity of irradiation was raised several times over that used by Raychaudhuri (*2*) who had found typical intensity independence of mutation rates. Any deviation from the effect of irradiation expected for 50 r at medium intensity would thus be due to a specific sensitivity or insensitivity of the aged sperm. The second possibility, interference by a time factor, was tested by increasing the intensity of irradiation, and the total dosage, by a factor of 2, that is, by administering 100 r instead of about 50 r through continuous gamma irradiation over 21 days. The third possibility, chance, was checked by a repetition of the original experiment, that is, by giving once more 52.5 r in gamma rays over 21 days. Parallel with each experiment, the spontaneous mutation rate was determined in a set of controls.

TABLE 1

MUTATION RATES FOR SEX-LINKED LETHALS IN SPERM OF *Drosophila melanogaster*, AFTER DIFFERENT TYPES OF TREATMENT

Treatment	No. of controls	No. of experimentals	Mutation rate percent: Controls	Experimentals	Difference	Significance of difference: χ^2	P
50 r, 2.3–5 min exposure, not aged (Spencer and Stern)	73,901	31,560	0.0974	0.2440	0.1466	33.67	$<<0.01$
52.5 r,* 21 days' exposure, aged (Caspari and Stern†)	56,252	51,963	0.2489	0.2848	0.0359	1.31	0.26
50 r,* 24 hr exposure after 20 days' aging	44,601	46,232	0.1682	0.2834	0.1152	13.31	$<<0.01$
100 r, 21 days' exposure, aged	22,958	31,562	0.2352	0.4658	0.2306	19.23	$<<0.01$
52.5 r,* 21 days' exposure, aged	36,184	29,424	0.1765	0.2542	0.0777	4.67	0.03

* Geometric errors in the administration of the radiation are larger than the difference between the values of 52.5 and 50 r.

† The mutation rates obtained by Caspari and Stern have been adjusted to the slightly different scoring of lethals used in the investigations reported in this paper.

The data, together with the earlier findings by Spencer and Stern (*3*) and Caspari and Stern (*1*), are summarized in Table 1. It is seen that all three new tests gave an increased frequency of sex-linked mutations in the treated sperm as opposed to the controls. The experimental rate observed by Caspari and Stern is statistically in good agreement with later determinations. The control rate of 0.2489% found by Caspari and Stern is higher than any one of the later control rates. By itself a rate of 0.2489% for sperm aged over 21 days as compared to 0.0974% for sperm not aged (Table 1, line 1) seemed in line with the degree of increase expected, according to the experience of other workers, after such aging. The new data on the control mutation rate in aged sperm suggest considerable variation of age accumu-

[1] The work described in this report was performed under the auspices of the Atomic Energy Commission.

lation of mutations in the Canton Special stock on which all tests were carried out.

A comparison of the differences in mutation frequencies between experimentals and controls in the chronic experiments (lines 2–5) with the difference in the acute experiment (line 1) should take into account the fact that the difference in the latter experiment is somewhat larger than expected on the basis of all of Spencer and Stern's data. The maximum likelihood calculation yields about 0.002% induced sex-linked mutations per r, which corresponds to an expected difference for the acute 50-r experiment of only 0.1000%. Viewing all experiments together, it appears that irradiation at low dosages, administered at low intensity, induces mutations in *Drosophila* sperm. There is no threshhold below which radiation fails to induce mutations. A more detailed account of the work will be presented later.

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An Electrical Logic Machine

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At the first annual open house meeting at Lewis Institute in 1936, the writer demonstrated an electrical Logic Machine useful for detection and demonstration of fallacies in deductive reasoning. The machine is equipped to test all syllogisms (categorical, hypothetical, and disjunctive), and both conversion and obversion. To facilitate portability, the machine is mounted inside the top half of a sturdy suitcase, with the classified blocks (representing propositions) resting in thin plywood compartments in the bottom half of the case. Total weight of the case, including machine and blocks, is 25 lb.

In order to test a syllogism, it is only necessary to select the blocks representing the major premise, minor premise, and conclusion, and place the blocks onto the three spaces provided on the panel of the machine. If the syllogism contains one or more fallacies, one or more light bulbs will light up. Each light bulb is identified by a printed name of a fallacy, as follows:

1. Undistributed middle.
2. Illicit major.
3. Illicit minor.
4. Two negative premises.
5. Two particular premises.
6. Affirmative conclusion from negative premise.
7. Universal conclusion from particular premise.

For the hypothetical syllogism, there are light bulbs for "Denying the antecedent," "Affirming the consequent," and "Hypothetical *non sequitur*." For the disjunctive syllogism, there is a light bulb for "Disjunctive *non sequitur*." There is one bulb for "False conversion," one for "False obversion," and a colored light bulb indicating that electrical current (battery or line) is established.

The principle of operation is that of establishing metal contact areas on the backs of flat wooden blocks, to convey information concerning the proposition printed on the front of the block. For example, the block representing the proposition "Some M is not S" (minor premise) has separate contact areas at selected positions on the back of the block, to represent the following items of information:

1. The middle term (M) is undistributed (that is, it refers to a limited number of its class).
2. The proposition is negative.
3. The proposition is particular (refers to "some").

Since, by definition, the conclusion of a syllogism represents the minor term by the letter S (subject), and the major term by the letter P (predicate), there are four blocks representing possible conclusions: All S is P, No S is P, Some S is P, Some S is not P. Using M for the middle term, there are eight blocks for all the possible combinations with P in the major premise, and eight blocks for the possible combinations with S in the minor premise. Additional blocks provide for testing hypothetical syllogisms, disjunctive syllogisms, conversion, and obversion.

Pairs of banana plugs in the panel receive items of information from the contact areas when the blocks are set onto the panel. Certain combinations of propositions will close one or more electrical circuits wired from the panel to pilot light bulbs. There is a separate circuit for each possible fallacy.

The panel is black hard rubber, 7 in. × 10½ in. × 3/16 in. To insure correspondence, a template was used to drill identically separated holes on both the panel and the wooden blocks, separated 5/16 in. horizontally, ¼ in. vertically. The banana plugs were inserted in the panel holes and secured with nuts behind the panel. The wiring is soldered to the back end of the plugs (behind the panel) and it leads to the pilot light sockets mounted on a vertical strip of black hard rubber. A white card next to the bulbs has a printed title for each kind of fallacy, indicated by the appropriate bulb. A knife switch permits use of either battery or line current; a transformer for line current is attached and wired behind the panel, out of sight. Panel, light sockets, and knife switch are mounted on a pressed cardboard backing, 17 in. × 14½ in. × ½ in. The backing is mounted inside the top of a suitcase.

The blocks are of hard wood, 5½ in. × 2½ in. × ¾ in. The contact areas consist of a pair of adjacent jacks soldered at their point of adjacency. The holes were drilled in the wood through the same template used for the panel, and were then widened to 3/16 in.; depth was ½ in. Then the blocks were sandpapered until they were smooth and easy to handle. The jacks were made from brass tubing, ¼ in. OD, 5/32 in. ID, cut into ⅜ in. lengths. One end of the jacks was trimmed down, to facilitate entry into the blocks. After each pair of jacks was hammered in, flush with surface, a narrow hole was drilled between the two

jacks, solder was inserted, and the jacks were countersunk after the solder hardened. Now the blocks could be set onto the banana plugs on the panel and would close certain parts of the circuits involved.

Earlier machines by Stanhope (*8, 1*), Jevons (*3, 4*), Venn (*9*), Marquand (*6*), Pastore (*7*), and Macaulay (*5*) generally indicated the conclusions derivable from given premises. None could identify the fallacy in deductive thinking. However, in an article written in 1935 on the mechanical nature of problem solving, Hull (*2*) mentioned that he once constructed a "simple mechanism of sliding disk-segments of sheet-metal which will solve automatically, i.e., exhibit the conclusions logically flowing from all of the known syllogisms and which will automatically detect all of the formal fallacies . . ." but that ". . . a description has not yet been published."

The logic machine described by the present writer is an electrical device which identifies the formal fallacy (or fallacies) in an invalid syllogism of the categorical, hypothetical, or disjunctive types, or in conversion and obversion. It has been used successfully in logic classes and evokes sharp student interest. As with all such machines, its obvious limitation is that the "argument" must first be put into logical form by a human being.

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The Application of Soybean Inhibitor in Tissue Cultivation

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It is well known that certain types of tissue cells liquefy clots of homologous plasma, thus making their permanent cultivation impossible. Carrel and Ebeling (*1*) attempted unsuccessfully to prevent such liquefaction by adding traces of unsaturated fatty acids, egg yolk and other substances to the medium. The present author (*2*) cultivated permanent strains of the Rous sarcoma cells *in vitro* for many years by putting a small piece of boiled muscle tissue beside the tumor tissue. The dead muscle tissue served as a kind of solid substrate which was invaded by the sarcoma cells and thus it made possible the transfer of the cells from medium to medium. This method of course did not allow quantitative estimations of the rate of growth characteristic for the tumor cells. Later we found that sarcoma cells grow readily on certain heterologous media without liquefaction of the medium, probably because the chicken cells are unable

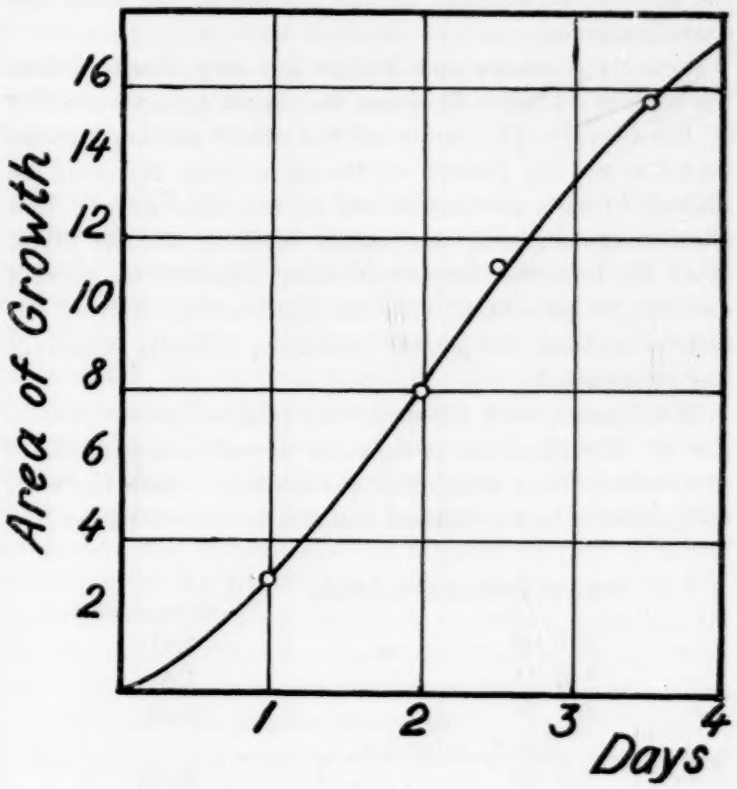

FIG. 1.

to activate the proteolytic enzymes in the heterologous plasma (*3*).

In this paper a method will be described for the cultivation of Rous sarcoma cells on clots of homologous plasma in which it was found that liquefaction could be prevented by an addition of the soybean inhibitor first isolated by Kunitz (*4*). In this manner it was possible to measure the rate of growth of the Rous chicken tumor cells in homologous plasma medium. The growth-retarding effect of soybean inhibitor on the growth of myoblasts will likewise be described and discussed.

The plasma medium in Carrel flasks was made up as follows: *Solid phase*—0.5 ml chick plasma, 1.0 ml Tyrode's solution, and 0.2 ml of a 0.35% solution of trypsin inhibitor; this was coagulated by adding 1 drop of embryo juice. *Fluid phase*—0.4 ml mixture of equal volumes of chick serum and Tyrode's solution, and 0.2 ml embryo extract.

Liquefaction of the medium was found to be completely prevented. Fig. 1 demonstrates the regular growth of the Rous sarcoma cells when cultivated in the presence of the inhibitor. The growth rate of the cells under the conditions of this experiment could now be accurately measured and was found to be relatively low. It therefore seems that the soybean inhibitor slows down the growth rate of the tumor cells.

Further it was found that the inhibitor prolongs the coagulation time of the plasma used. In those of our

experiments in which the inhibitor was added to the blood plasma and not to be supernatant fluid of the flask cultures the coagulation of the plasma was found to be considerably delayed or completely prevented, even when large amounts of embryo juice was added. These facts suggest that the inhibitor acts on the system involved in the coagulation of the blood plasma as well as on the proteolytic enzymes of the surface of the cells, the desmo-enzymes.

Recently Overman and Wright (*5*) have observed that the trypsin inhibitor decreases the thromboplastic activity of the blood. The study of the effect of the soybean inhibitor on the growth of the cells must therefore be limited to such concentrations of inhibitor as will still allow coagulation of the plasma medium to take place. When the inhibitor, instead of being added to the plasma directly, is introduced into the supernatant fluid of the culture medium, the growth-inhibiting effect is relatively less pronounced.

The figures below illustrate the relative growth inhibition of fibroblasts as a function of increasing amounts of a rather dilute solution of the inhibitor which has been *introduced into the plasma medium* before clotting:

0.17% inhibitor solution	$Q = \frac{\text{Control}}{\text{experiment}}$[1]
0.1 ml	1.01
0.2 "	1.43
0.3 "	2.24
0.35% inhibitor	
0.2 ml	2.22

Thus when more than 0.3 ml of a 0.17% solution of the inhibitor is added to the plasma clot, no further suppression of the growth takes place. This seems to indicate that the proteolytic enzymes are completely inhibited by that concentration.

The following results show the effect of a 0.7% inhibitor *added to the fluid phase of the culture medium*:

0.7% inhibitor solution	$Q = \frac{\text{Control}}{\text{experiment}}$
0.25 ml	1.44
0.30 "	1.20
0.35 "	1.18

To establish a certain degree of growth inhibition of tissue cells in a Carrel flask the concentration of inhibitor has to be four times that necessary to obtain the same degree of inhibition when the inhibitor is introduced in the solid phase of the plasma clot.

Two main facts have been observed in this investigation. The soybean inhibitor has been shown to be an important tool in the tissue cultivation technique. An addition of small amounts of inhibitor to the plasma medium stabilizes the clot and makes it possible to cultivate on homologous media tissues with strong inherent proteolytic activity. Thus it is now possible to cultivate malignant cells indefinitely and to make quantitative estimations of the rate of their growth. It will also be possible now, we believe, to study differentiation phenomena *in vitro* by means of suppressing the growth of the cells and slowing down their migration rate.

[1] The tissue area increase is measured by means of a planimeter and expressed in square centimeters, the area being projected with the aid of an Edinger projector enlarging 20 times. Q is a measure for the inhibiting effect.

We are grateful to Professor Kunitz for supplying the crystalline trypsin inhibitor, and to the International Cancer Foundation, which provided financial support.

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Occurrence of Vitamin B_c Conjugase in Human Plasma

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The occurrence in yeast extract of an antianemic principle, different from pteroylglutamic acid, but releasing that substance after acid or enzymatic hydrolysis, was first demonstrated by Binkley, *et al.* (*1*). Pfiffner (*2*) isolated this compound and named it temporarily vitamin B_c conjugate.

In 1947 Schweigert and Pearson (*3*) studied the folic acid content of blood plasma and corpuscles in Mammalia and fowl, before and after treatment with an enzyme, takadiastase, releasing folic acid from its microbiologically inactive forms. They could find only minute amounts of free folic acid, but it seemed from their experiments that vitamin B_c conjugate was present in significant amounts.

TABLE 1

Folic Acid Released after 2-hr Incubation at 37° C of a Mixture of Human Plasma and Takadiastase*

Plasma ml	Takadiastase mg	B_c released mμg
0.5	20	25
0.5	20 (boiled)	25
0.5 (boiled)	20	2
none	20	1.6
0.5	none	0

* Microbiological determination with *Str. faecalis*.

A careful study of the interaction between takadiastase and plasma, both in the native state and after boiling for 10 min, has led to opposite results (*4*). The plasma is deprived of B_c conjugate, but it contains a thermolabile enzyme, which releases folic acid from a conjugate. The role of takadiastase in this interaction is that of a substrate containing vitamin B_c conjugate in significant amounts. Folic acid is set free, see Table 1, after incu-

bation with plasma for 2 hr at 37° C,[1] the pH of the digestion mixture being 4.5.

Striking results were obtained with a crude extract of baker's yeast (containing 3.7 μg B_c per cc in conjugated form) from which 0.2 cc plasma liberated 0.7 μg folic acid in 1 hr at 37° C.

Additional evidence of the enzymatic role of plasma is offered by the use, as substrate, of pure crystalline vitamin B_c conjugate,[2] which gives identical results.

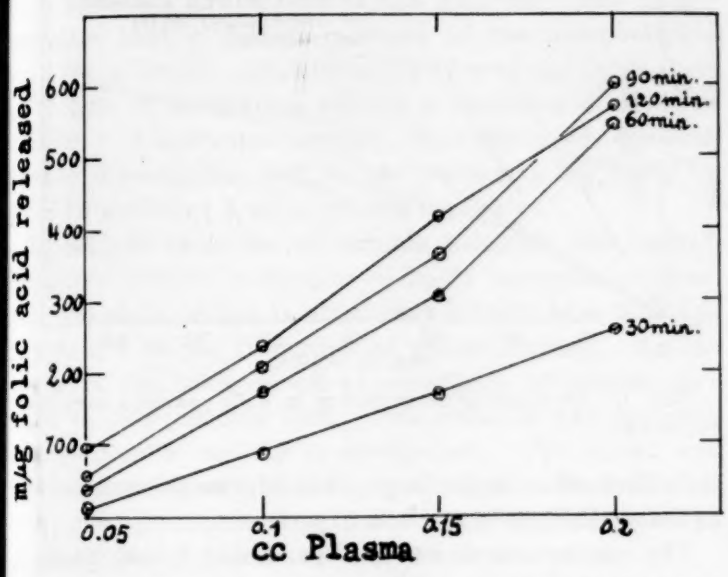

FIG. 1. Liberation of folic acid after various incubation periods at 37° C of 0.5 cc yeast extract + human plasma + 5 cc sodium acetate m/10 at pH 4.5 + water (total volume = 10 cc).

The B_c release as a function of plasma concentration for a constant time of incubation is represented in Fig. 1. There appears to be a linear relationship for plasma concentrations, ranging from 0.05 cc to 0.15 cc.

The study of human plasma conjugase activity in normal and pathological conditions has given the following results: under standard conditions, viz., with incubation at 37° C and pH 4.5, a mixture of 0.15 cc heparinized plasma and 0.5 cc yeast extract made up to a volume of 10 cc, liberated 0.5 μg to 1.5 μg folic acid per cc plasma in 90 min, with a maximum frequency of 0.8 μg to 1.0 μg. No significant variation of conjugase activity could be detected in pernicious anemia or in other pathological conditions, with the exception of asystolic patients, where the amount of conjugase per cc plasma was sometimes considerably decreased and attained values of 0.2 μg to 0.7 μg folic acid.

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[1] In a recent communication published while this article was in press, Simpson and Schweigert came to similar conclusions. (*Arch of Biochem.,* 1949, **20**, 32.)

[2] Crystalline vitamin B_c conjugate used in this experiment was supplied by Parke, Davis & Co. Laboratories, Detroit.

The Effects of Choline and Methionine on Phospholipide Formation in Patients with Liver Disease as Measured by Radioactive Phosphorus[1]

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In the past ten years the importance of nutritional factors in the pathogenesis and prophylaxis of experimentally induced cirrhosis in animals has resulted in a modification of the therapeutic regime in human patients. Of special interest has been the use of a diet high in protein and the administration of vitamin supplements, liver extracts, and lipotropic factors, such as methionine and choline. The efficacy of the above regimen is reflected in the lower mortality figures now being reported in the treatment of advanced instances of cirrhosis (*3*). In general this improvement is ascribed in part to a regenerative action on the liver tissue and in part to the lipotropic action of methionine and choline, resulting in the removal of the fat accumulated in the liver. The latter effect has been interpreted as being due to an increased formation of phospholipides.

In experimental animals with dietary fatty liver it has been shown, by the use of radioactive phosphorus as an indicator, that the administration of choline (*2*) or methionine (*8*) causes an increase in the rate of the synthesis of phospholipides in the liver. Since the plasma phospholipides are synthesized almost entirely in the liver (*5*), it seems that changes in the rate of formation of liver phospholipides would be reflected by corresponding changes in the amounts of newly formed phospholipides in the plasma. Indeed, in dogs on a diet low in protein and high in fat (*7*) a stimulatory effect by choline on the turnover of phospholipides in plasma has been observed.

We now have in progress a systematic study of the turnover of plasma phospholipides in normal human beings and in patients with various diseases. Some preliminary findings have been reported in a summarized form (*4*) and more extensive data will be published elsewhere. We are here reporting only some results obtained in two cirrhotic patients who exhibited a marked response to a single large dose of methionine or choline. These results suggest certain possibilities which might be of considerable interest in the interpretation and treatment of this disease.

One 31-year-old white male (O.A.) and one 36-year-old

[1] Supported in part by a grant from the U. S. Public Health Service. The P^{32} used in these experiments was obtained from the National Laboratories, Oak Ridge, Tennessee on allocation from the U. S. Atomic Energy Commission.

[2] We wish to acknowledge the helpful suggestions and constructive criticism of Dr. Camillo Artom and the technical assistance of Dr. Benjamin Vatz and Mr. Jesse C. Trott, Jr.

white female (N.M.H.) having clinical evidence of advanced portal cirrhosis were studied. At the time of admission, both were jaundiced and had demonstrable ascites, edema, and hepatic enlargement. Both gave a history of marked alcoholism. Definite impairment of liver function was found, as demonstrated by determinations of total serum proteins, albumin and globulin, vitamin A levels and by various tests, such as bromsulphalein,

TABLE 1

EFFECT OF LIPOTROPIC AGENTS ON SPECIFIC ACTIVITY OF PLASMA PHOSPHOLIPIDES

Patient	Treatment	Time in hr	Plasma phospholipides: Radioactivity per 100 cc* r.r.u.	Plasma phospholipides: Mg phosphorus per 100 cc†	Plasma phospholipides: Specific activity‡ × 100
O.A.	Injection of P^{32} + 9g choline orally	0	....	11.70	...
		24	1.785	11.16	16.0
		48	1.740	10.25	17.0
	P^{32}	0	....	7.96	...
		24	0.450	6.96	6.4
		48	0.766	6.23	12.3
		84	1.356	8.92	15.1
	P^{32} + 9g choline orally	0	....	11.25	...
		24	0.710	11.72	6.1
		48	1.012	11.36	8.9
N.M.H.	P^{32} + 6g methionine I.V.	0	....	11.84	...
		24	3.810	11.10	34.3
	P^{32}	0	....	9.01	...
		24	0.531	6.41	8.3
		48	1.270	7.60	16.7
		72	1.770	9.40	18.8
	P^{32} + 10g methionine I.V.	0	....	5.11	...
		24	0.712	6.70	10.6
		48	1.334	8.28	16.1
		72	1.700	9.68	17.5

* Expressed in relative radioactivity units (r.r.u.), the total dose injected being equal to 10^4 r.r.u.

† From the lipide P the total plasma phospholipide can be calculated (mg of P × 22.7).

‡ The specific activity is the ratio of the radioactivity (in r.r.u.) to the phosphorus (in mg) in the lipide extracts.

galactose tolerance, and hippuric acid excretion. In both instances, needle aspiration biopsy of the liver showed cirrhosis and fatty infiltration.

The patients were given an intramuscular injection of radiophosphorus in the form of Na_2HPO_4 (0.5 mc). Blood samples were taken routinely at 0, 24, 48, and 72 (or 96) hr. The plasma was separated and the lipids extracted with hot alcohol, alcohol-ether, and chloroform. On aliquots of the chloroform solution, the radioactivity (*1, 2*) and the phosphorus (*6*) were determined. At the time of the first injection of the radiophosphorus, the patients were given a single large dose of methionine (6 g intravenously to patient N.M.H.), and choline chloride (9 g orally to patient O.A.). After several months of treatment with methionine (1 g three times per day), the patients were reinjected with radiophosphorus (without simultaneous administration of the lipotropic agents) and the determinations were repeated on the plasma lipids. Two months later, a third experiment was made, in which

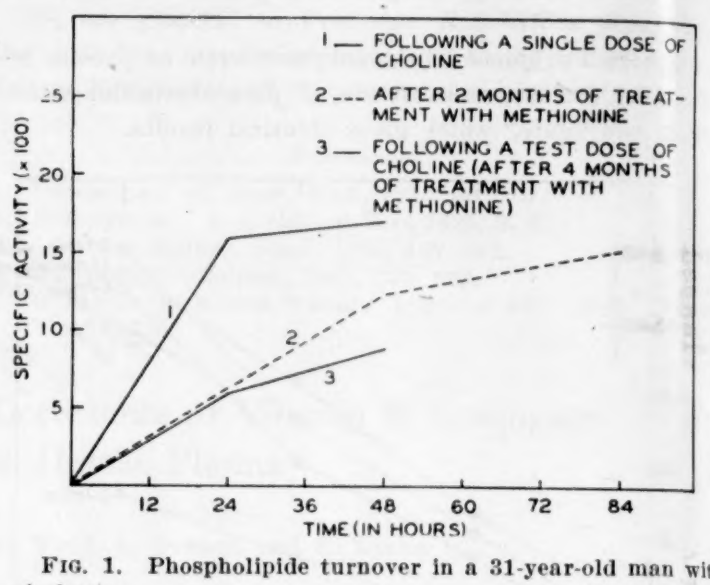

FIG. 1. Phospholipide turnover in a 31-year-old man with cirrhosis.

the effect of a single large dose of the substances was again studied, as in the first experiment.

The results are shown in Figs. 1 and 2 and Table 1. In the two cirrhotic patients previously untreated, the specific activity values of the plasma lipids following the initial large dose of methionine or choline were considerably higher than the corresponding values found in the same patients in later periods, with or without administration of the massive dose of lipotropic substances. It seems logical to conclude that in these patients the initial large dose of the lipotropic substances actually caused a marked increase in the rate of phospholipide turnover and that such an increase was no longer obtainable after prolonged therapy with methionine. This last finding is in keeping with similar results we have obtained in a number of other patients who were also treated with

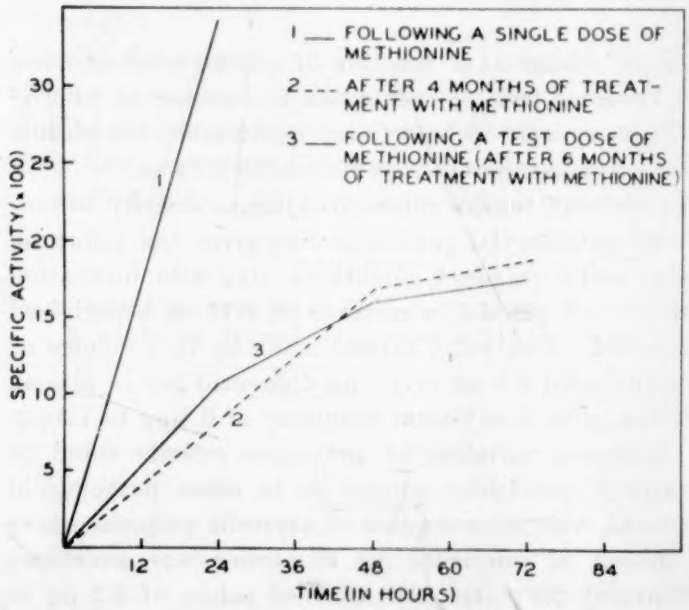

FIG. 2. Phospholipide turnover in a 36-year-old woman with cirrhosis.

methionine over a long period of time (*4*). In animals on choline-deficient diets, the administration of choline caused a marked stimulation of the turnover of liver and plasma phospholipides; this effect is smaller or undetectable in animals maintained on adequate diets. In other words, in experimental animals the stimulating action of a large dose is only evident when the supply of choline or choline precursor is insufficient.

These observations suggest a tentative interpretation of our present findings on human patients. One might postulate that a definite increase in the phospholipide turnover after the administration of a single large dose of choline or methionine reflects a condition of relative deficiency in lipotropic agents. This hypothesis deserves further investigation and we are continuing our study in order to arrive at a more definite conclusion.

In certain instances of chronic hepatitis, the use of lipotropic factors is thought to be of therapeutic value. This beneficial effect is attributed largely to a stimulatory action on the formation of phospholipides. An increase in the turnover of phospholipide in plasma was noted in two patients with portal cirrhosis who received a large dose of choline or methionine. This effect was no longer demonstrable after prolonged treatment with lipotropic agents, although the patients exhibited clinical and laboratory evidence of marked improvement.

It is suggested that the stimulation of phospholipide turnover caused by a single large dose of choline or methionine may indicate a deficiency of lipotropic material, and thus provide an estimate of the anticipated response to the treatment of cirrhosis with lipotropic substances.

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Evidence for the Conversion of Carbon Monoxide to Carbon Dioxide by the Intact Animal

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Conversion of CO to CO_2 by animal tissues was suggested and to some extent demonstrated by Fenn and Cobb (*5*) to account for the marked increases in gas consumption observed when isolated tissues, particularly muscle, were exposed to an atmosphere containing about 80% CO in oxygen. The phenomenon was confirmed by Schmitt and Scott (*9*) and shown to be superimposed on inhibition of the cytochrome-cytochrome oxidase system by Stannard (*10*). The ability of an intact animal to accomplish this conversion, however, has never been demonstrated. In fact, there have been numerous arguments against the presence of such a phenomenon (*6, 7*), the most recent of which is found in the results of Tobias *et al.* (*11*), in which radioactive carbon (as $C^{11}O$) was employed. They found that less than 0.1% of the CO lost from the blood could be recovered as $C^{11}O_2$ in the expired air.

TABLE 1

Disappearance of CO from Closed Chamber (60 Liters) with and without Turtles*

Exp.	Time†	Total weight of turtles	Initial CO concentration	Amount consumed: With turtles	Amount consumed: Control	Amount consumed: Difference	CO consumed
	days	g	%	ml	ml	ml	%
1	8	2080	0.023	5.92	0.00	5.92	41
2	7	4826	0.020	7.71	1.20	6.51	52
3	13	4880	0.038	12.03	2.68	9.35	48
4	11	4662	0.047	14.86	1.08	13.78	49
5	10	2946	0.075	13.30	0.00	13.30	30

* Gasometric experiments, values expressed at STP.
† Number refers to duration of *each* period, control and experimental.

With the availability of C^{14} and recent refinements in methods for the determination of very small amounts of CO, it was considered of interest to repeat the experiments done in this laboratory with isolated tissue and to extend them to the intact animal. The results with isolated tissue have been reported elsewhere (*3, 4*). Suffice it to say that the oxidation of CO to CO_2 by skeletal and cardiac muscle observed earlier by indirect gasometric and volumetric procedures was quantitatively reproduced in direct experiments measuring conversion of $C^{14}O$ to $C^{14}O_2$.

In the experiments with intact animals reported here, two methods were applied: (a) gasometric measurement of the CO disappearing from a closed chamber, using a modification of the extremely sensitive Roughton-Root technique (*8*), and (b) collection of the expired CO_2 from animals residing in an atmosphere containing CO, some of which was the radioactive $C^{14}O$, and measurement of radioactivity by the method of Bale, *et al.* (*1*).

Table 1 shows the amount of CO lost, measured by the gasometric method, in five experiments with turtles. Expired CO_2 was collected in soda lime placed within the chamber, and oxygen was added automatically as needed from a small spirometer through a check-valve system. Any CO removed for sampling was replaced by introduction of an equal amount from a syringe. Samples were taken initially, after an equilibration period of 10–12 hr and then either daily or at the end of the test period.

[1] Now at Abilene Christian College, Abilene, Texas.

It is clear that the amount of CO lost when the animals are present is large compared with that disappearing when only soda lime, food, accumulated feces and urine, etc. are present. It is also large compared with the amounts required to saturate blood and tissues at the CO tensions employed. The elapsed times are far greater than those necessary for equilibration of the gas with blood, tissues, and soda lime. Furthermore, samples taken at daily intervals indicated a more or less constant rate of disappearance (i.e., the CO does not all disappear during the equilibration period).

TABLE 2

DISAPPEARANCE OF CO FROM CLOSED CHAMBER (12.5 LITERS) WITH AND WITHOUT MICE*

Time	Total weight of mice	Initial CO concentration	Amount consumed		Rate of loss
			With mice	Control	
days	g	%	ml	ml	mm³/g/hr
4	246	0.071	4.49	0.13	0.20
4	294	0.089	8.16	0.84	0.26

* Gasometric experiment, values expressed at STP.

A similar experiment with mice is shown in Table 2. The initial concentrations were somewhat higher than in the experiments with turtles, but these represent only a moderately toxic level for mice. The CO concentration was determined initially, after an equilibration period of 10–12 hr, and again at the end of the experiment. The control period duplicated the experimental except for the absence of the animals. The data indicate disappearance of CO at a rate approximating 0.24 mm³/g body wt/hr.

The C^{14}-labeled CO was prepared by release of CO_2 from $BaCO_3$ having a specific activity of 384 μc per g of carbon. This CO_2 was reduced to CO after the method of Bernstein and Taylor (*2*). The conversion was practically quantitative, and this CO was used to prepare the mixture in the exposure chamber. The apparatus and conditions were otherwise similar to those in the gasometric experiment. Radioactive measurements were made with the CO_2 in gaseous form (*1*).

The results of the two experiments using mice are summarized in Table 3. While small amounts of radioactivity appeared in the alkali in the absence of the mice, due probably to solution of CO plus conversion to formate, it is obvious that the amounts of C^{14} appearing as $C^{14}O_2$ are many orders of magnitude higher in the presence of the animals. The phenomenon is clear, and the rate of CO oxidation calculated from isotope experiments agrees remarkably well with that obtained earlier by the gasometric procedure. While the specific activities in the collected CO_2 are low compared to the original CO, actually for each gram of carbon present as CO in the chamber, 22.3% and 19.3% respectively were converted to CO_2 in the two experiments.

The CO oxidation rate by the intact mouse is about 10 times that expected from a linear extrapolation of the rates obtained with isolated frog muscle at 80% CO to those expected at 0.07% CO. Allowing for the temperature difference (from 25° to 38° C), this indicates that mammalian muscle in the body effects this conversion at rates roughly equivalent to those expected from earlier work on isolated tissue. If applied to man, this rate would predict oxidation of CO at approximately 20 ml/hr if air containing 0.07% CO is breathed. It should be stated, however, that, if the rate observed by us in mice actually occurs in man, it should have been observable by the technique used by Tobias *et al.* (*11*). However, if the conversion is slow to start, the short times involved in their experiments might have prevented observation of the phenomenon.

TABLE 3

CONVERSION OF CO TO CO_2 BY MICE*

Time	Total weight of mice	Initial CO concentration	Activity measurements of $C^{14}O_2$ collected			Rate of conversion
			With mice		Control	
days	g	%	d/min × 10³	specific activity μc/g carbon	d/min × 10³	mm³/g/hr
2.67	57	0.07	459†	0.06	0.63	0.28
2.00	47	0.07	306	0.052	2.54	0.29

* Experiment with radioactive carbon monoxide ($C^{14}O$).
† That is, 459,000 disintegrations per minute.

The possible significance of these findings will be discussed in a more complete paper. Obviously, the mechanism of this reaction in tissues and its apparent limitation to muscle presents an interesting biochemical problem.[2]

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[2] Experiments with radioactive C^{14} in this paper were conducted in part under a contract with the U. S. Atomic Energy Commission at the University of Rochester Atomic Energy Project, and another between the Office of Naval Research and the University of Rochester. The cooperation of Drs. W. F. Bale, R. W. Helmkamp, and their assistants is gratefully acknowledged. This work is part of a program supported by the Air Materiel Command, Wright Field.

Comments and Communications

Color Standards for Biologists

There is a movement on foot to prepare a modern color chart, adequately standardized, and comprehensive enough to meet the requirements of all biologists, horticulturists, and technical agriculturists.

The subject was discussed last autumn by a group of biologists at the University of Toronto, who asked the National Research Council of Canada to set up a special committee to find out what Canadian biologists thought about color standards. The committee met on December 15, 1948, and drafted a questionnaire, which was later sent out to approximately 200 biologists and workers in related fields, mostly in Canada, but also a few in the United States, England, and France. One hundred and forty-one replies were received, a proportion which in itself demonstrates a lively interest in the subject.

The answers showed that Ridgway is the chart most familiar to the biologists and most used by them, followed by the Royal Horticultural Society's charts, and the *Munsell Book of Color,* in that order. The committee was not at all surprised at this result.

The question whether the worker would use a standard chart if it were available was answered in the negative by only 14 workers, mostly in the fields where color is not a major problem. As to the desirable form for such a publication, there was naturally a great diversity of opinion, reflecting the special interests of those who replied. A very large range of colors would undoubtedly be required, and in the interests of economy some loose-leaf or similar method of presentation would be essential, so that each worker might purchase only the range of colors useful in his specialty. A format suitable for field use was generally desired. There was almost unanimous agreement that each color must have a name, and so it appears that the numerical specification of color, familiar to physicists, is not yet acceptable to biological workers. The committee found it interesting to speculate on what the present state of descriptive biology might be, if the I.C.I. colorimetric system had been available to Linnaeus.

The final question referred to the permanence of color charts. Of those who answered, 35 were sure that their charts were changing significantly with the passage of time, 17 thought that they were not, and 8 were doubtful.

Discussing all these replies, the committee felt the results of this small survey showed clearly that many biologists are interested in a color standard prepared especially for their use. One excellent reason for the preparation of such a standard was suggested in one of the replies, which referred to the Plant Patents Act and the desirability of having some standard color reference for legal purposes.

A report on this questionnaire was presented to the Inter-Society Color Council at its New York meeting on March 9. The matter was referred to the Problems Committee of the I.S.C.C. for further study. Several members expressed the hope that some national organization of biologists would apply for membership in the I.S.C.C. and take an active interest in the project.

W. E. K. Middleton

Division of Physics,
National Research Council,
Ottawa, Canada

Scientific Book Register

Andronow, A. A., and Chaikin, C. E. (Solomon Lefschetz, Ed.) *Theory of oscillations.* Princeton, N. J.: Princeton Univ. Press, 1949. Pp. ix + 358. (Illustrated.) $6.00.

Beyer, Robert T. (Ed.). *Foundations of nuclear physics: facsimiles of thirteen original studies.* New York 19, N. Y.: Dover Publ., 1949. Pp. 272. (Illustrated.) $2.95.

Cameron, Edward A., and Browne, Edward T. *College algebra.* New York: Henry Holt, 1949. Pp. iii + 406. $3.00.

Carter, Herbert E. (Ed.) *Biochemical preparations.* (Vol. 1.) New York: John Wiley; London: Chapman & Hall, 1949. Pp. xi + 76. $2.50.

Case, Earl C., and Bergsmark, Daniel R. *College geography.* (3rd ed.) New York: John Wiley, 1949. Pp. x + 790. (Illustrated.) $5.00.

Hodges, Margaret B. (Ed.) *Social work year book 1949: a description of organized activities in social work and in related fields.* (10th issue.) New York: Russell Sage Foundation, 1949. Pp. 714. $4.50.

Lefschetz, Solomon. *Introduction to topology.* Princeton, N. J.: Princeton Univ. Press, 1949. Pp. viii + 218. (Illustrated.) $4.00.

Milne, E. A. *Kinematic relativity: a sequel to relativity, gravitation and world structure.* New York: Oxford Univ. Press; Oxford, Engl.: Clarendon Press, 1948. Pp. vi + 238. $6.50.

Pace, Edgardo. *Le vitamine: la chimica, la tecnica farmaceutica, l'azione biologica, i metodi di ostrazione e di sintesi.* Milan, Italy: Ulrico Hoepli, 1949. Pp. xii + 422. (Illustrated.) 2,000 lire.

Rosseland, Svein. *The pulsation theory of variable stars.* New York: Oxford Univ. Press, 1949. Pp. viii + 152. (Illustrated.) $5.00.

Sisam, Charles H. *Analytic geometry.* (Rev. ed.) New York: Henry Holt, 1949. Pp. xvi + 304. $2.40.

NEWS and Notes

The Interstate and Foreign Commerce Committee of the House of Representatives endorsed the **National Science Foundation bill, H. R. 4846,** on June 13 and recommended its passage by the House of Representatives. Scientists interested in the establishment of the Foundation can now inform their Representatives that they too recommend the passage of H. R. 4846.

The American Medical Association has appointed five medical educators as its representatives at congressional committee hearings in Washington on national health insurance legislation. They are: **Creighton Barker,** Yale Medical School; **Donald Grigg Anderson,** dean of the Boston University School of Medicine; **William Harvey Perkins,** dean of Jefferson Medical College, Philadelphia; **William Shainline Middleton,** dean of the University of Wisconsin's Medical School; **Herman G. Weiskotten,** dean of the College of Medicine, Syracuse University.

Paul E. Klopsteg, director of research at Northwestern University Technological Institute, has been elected chairman of the board of governors of the Argonne National Laboratory; **Warren Johnson,** chairman of the Department of Chemistry at the University of Chicago, was elected vice chairman.

Selig Brodetsky, formerly professor of mathematics at Leeds University, England, has been appointed president of the Hebrew University, Jerusalem. Dr. Brodetsky succeeds the late **Judah Magnes.**

Eugene W. Scott, assistant executive secretary of the Research and Development Board of the National Military Establishment, has been appointed executive secretary of the Interdepartmental Committee on Scientific Research and Development.

George Herman Wise has been appointed head of the Nutrition Section of the Department of Animal Industry at North Carolina State College.

Harold M. Skeels has joined the staff of the National Institute of Mental Health, U. S. Public Health Service. Dr. Skeels has been assigned to the Community Services Branch of the institute for duty as mental health consultant in clinical psychology in San Francisco.

Visitors to U. S.

Fritz Feigl, analytical chemist with the Laboratory of Mineral Products of the Brazilian Ministry of Agriculture, Rio de Janeiro, will take part in the Second Annual Analytical Symposium sponsored by the American Chemical Society's Division of Analytical and Microchemistry and the society's publication *Analytical Chemistry,* to take place at Wesleyan University, Middletown, Connecticut, on June 24–25. His subject will be "The Role of Organic Reagents in the Chemistry of Specific, Selective, and Sensitive Reactions."

Visitors at the National Bureau of Standards during the week of May 23–27 included **C. B. Amphlett,** of the Atomic Energy Research Establishment, Harwell, England; **H. A. Wills,** of the Australian Commonwealth Department of Supply and Development, Division of Aeronautics; and **J. Yofe,** head of the Chemical Laboratory of the Standards Institution of Israel.

Lord Horder, chairman of the Empire Council on Rheumatism, and physician to King George VI of England, lectured at the International Congress on Rheumatism in New York City on May 30, and at the convention of the American Medical Association in Atlantic City, June 6–10.

Segismundo Gerszonowicz, director of the Instituto de Electrotecnica, University of Montevideo, who has been visiting lecturer at the Graduate School of Engineering, Harvard University, will return to Montevideo this month.

Grants and Awards

The University of California School of Medicine has awarded $7,500 to Abraham White, chairman of the Department of Physiology and Chemistry. Dr. White will investigate the biochemistry of normal and malignant lymphocytes in an effort to further understanding of one type of leukemia.

The **Patron's Medal of the Royal Geographical Society of Great Britain** has been awarded to Hans Pettersson, of the University of Gothenburg, Sweden, for a recently completed deep-sea expedition during which he made a number of oceanographical discoveries.

Fellowships

The American Cancer Society, in conjunction with the British Empire Cancer Campaign, announces a number of **British American Exchange Fellowships in Cancer Research.** These fellowships are open to American citizens who possess the degree of M.D., Ph.D., or D.Sc. and will provide specialized training in Great Britain; an equal number of young British scientists will be selected for training in this country. The fellowships, to be awarded by the society upon recommendation of the Committee on Growth of the National Research Council, will be granted for a period of one year at $4,020, with travel allowance of $600. Applications may be procured from and submitted at any time to the Executive Secretary of the Committee on Growth, Division of Medical Sciences, National Research Council, 2101 Constitution Avenue, Washington 25, D. C. The time of training will be arranged at the convenience of the institution and the fellow.

Colleges and Universities

California Institute of Technology dedicated its new $407,000 Earhart Plant Research Laboratory on June 7. Frits Went, professor of plant physiology in the Biology Division, is director of the laboratory.

By control of the temperature, humidity, light, and gas content of the air within the laboratory, a wide

range of climatic conditions will be simulated to study their effects on plant growth. All greenhouses are equipped with de-ionized water and compressed air and are kept sterile. A prefocused camera, containing enough film for eight hundred pictures, will photograph plants at desired intervals. Time will be recorded in centidays—periods of 14 minutes and 24 seconds each. Clocks are so placed that they will appear in each photograph and record the exact time of exposure. Research at the laboratory is aimed at matching plants to climate for better crop production.

Northwestern University geographers will begin a one-year study of Puerto Rico's agricultural problems on July 1. Clarence F. Jones, professor of geography, will direct the program, aided by Simon Rottenberg, director of the Social Science Research Center of the University of Puerto Rico; Rafael Pico, chairman of the Puerto Rican Planning, Urbanizing, and Zoning Board; and G. Donald Hudson, chairman of Northwestern's Department of Geography. The program will be supported by a $16,000 grant from the University of Puerto Rico and the board. The project, which involves land classification and a study of present and future use of the land, is an effort to solve the island's major problem—population pressure on the land. It is expected that the project will also provide basic knowledge applicable to other humid tropical areas.

The San Gorgonio Section of the American Chemical Society was recently formed at the University of California Citrus Experiment Station at Riverside. Linus Pauling, national president of the American Chemical Society, presented the charter to the new section and Frances Gunther, section chairman, gave an address on "Valence and Structure of Metals."

Meetings and Elections

The 12th International Conference on Public Education will be held in the Palais Wilson, Geneva, July 4–12 under the sponsorship of Unesco and the International Bureau of Education. Techniques used by various countries for teaching natural science, geography, and reading will be reviewed. Seventy-three states have been invited to send delegates.

A communication received from the secretary general of the **Seventh International Botanical Congress,** to be held in Stockholm, Sweden, July 12–20, 1950, states that presessional excursions will start on June 27 and postsessional excursions will end on August 9. Communication No. 2 from the Organizing Committee, containing the preliminary outline of the program and preliminary plans for the excursions, may be obtained from Dr. Ewart Aberg, Secretary General, Uppsala 7, Sweden.

The 1949 Plant Science Seminar will be held at the University of Wisconsin School of Pharmacy August 21–27. Persons interested in attending should write to Dr. Joseph V. Swintosky, Local Secretary, Plant Science Seminar, University of Wisconsin School of Pharmacy, Madison 6, Wisconsin.

The Pennsylvania Academy of Science elected the following officers at its 25th anniversary meeting April 15–16: Richard Foose, of the Geology Department, Franklin and Marshall College, president; and Harry K. Lane, of Hershey Junior College, secretary-treasurer.

The summer meeting of the academy will be held at Stroudsburg and Buck Hills Falls in August.

The Iowa Academy of Science, at its 61st meeting on April 15–16, elected as 1949–50 officers: J. B. Culbertson, Cornell College, president; Paul S. Helmick, Drake University, vice president; F. G. Brooks, Cornell College, editor; and Cornelius Gouwens, Iowa State College, secretary-treasurer and representative on the AAAS council.

The North Dakota Academy of Science elected the following officers for the academic year 1949–50 at its 41st annual meeting held jointly with the Red River Valley section of the American Chemical Society, May 6–7: president, Ralph E. Dunbar, North Dakota Agricultural College; and vice president, A. K. Saiki, University of North Dakota. G. A. Abbott, of the university, was reelected secretary-treasurer. J. Alex Munro, of the Agricultural College, was renamed representative on the AAAS council.

The Kentucky Psychological Association elected the following officers at its annual meeting held May 21 at the University of Kentucky: president, George A. Muench, University of Louisville; president-elect, Frank A. Pattie, University of Kentucky; and secretary-treasurer, Priscilla Alden, Nichols Veterans Hospital.

The University of Pennsylvania Chapter of the Society of the Sigma Xi elected the following officers to serve during the academic year 1949–50: president, Gaylord P. Harnwell, Department of Physics; vice president, Eugene P. Pendergrass, Department of Radiology of the hospital; and secretary, Harry E. Morton, Department of Bacteriology, School of Medicine. S. Reid Warren, Moore School of Electrical Engineering, continues as treasurer.

Academic Press, Inc. announces the publication of a new journal *Experimental Cell Research,* sponsored by the **International Society for Cell Biology.** The new journal will publish papers dealing with experimental analysis of the activity, structure, and organization of the cell and its sub-units, including work on virus. Technical or theoretical papers aiming at the further development of methods in the field of experimental cytology will also be included. Papers may be submitted in English, French, or German.

Experimental Cell Research will be edited by Törbjorn Caspersson, Stockholm; Honor Fell, Cambridge, England; John Runnström, Stockholm; Francis O. Schmitt, Cambridge, Massachusetts; Paul Weiss, Chicago, Illinois; and Ralph W. C. Wyckoff, Bethesda, Maryland. J. F. Danielli, London, will act as editor of communications for the society.

Authors residing in the western hemisphere should send their papers to U. S. editors; those residing in

the British Isles should mail theirs to Dr. Honor Fell, Cambridge; papers originating in other countries should be forwarded to the Scandinavian editors.

One volume, consisting of four issues, will be published annually.

The Chicago Natural History Museum's 15th Southwest Archaeological Expedition left June 8 for west central New Mexico. Paul S. Martin, chief curator of the museum's Department of Anthropology, heads the expedition; John B. Rinaldo, associate in archaeology, is his assistant. The expedition will work in Pine Lawn Valley, about one hundred miles north of Silver City, where they will resume their hunt for traces of prehistoric inhabitants during the various periods between 3000 B. C. and 1000 A. D.

The New School for Social Research in New York City has expanded its science program to include a group of six courses on biochemistry to be offered to the public free of charge this fall. The lectures will be given jointly by the New School and the Institute for Muscle Research, under the direction of Albert Szent Gyorgi, Hungarian scientist. The courses will run from seven to 16 weeks. The first two. "Dynamics of Living Things," and "Dynamics of Muscle as a Living System," are designed primarily for nonscientists and will emphasize the fusion of the sciences into a single unit based on the knowledge of the atom. Speakers scheduled for these lectures include Dr. Gyorgi and Otto Warburg, both of the Institute for Muscle Research; Otto Loewi, research professor of pharmacology, New York University College of Medicine; and Otto Meyerhof, research professor in physiology, University of Pennsylvania. These specialized courses will be presented mainly by the institute staff. The other four courses, designed more expressly for scientists, will cover "Biochemistry of Muscle," "Blood and Some Aspects of Its Functions," "Elementary Introduction to Quantum Mechanics and Some Biological Applications," and "Quantum Chemistry and Its Biological Applications."

David M. Delo, chief of Scientific Manpower for the Research and Development Group, Logistics Division, General Staff, U. S. Army, has been appointed the first executive director of the **American Geological Institute**, effective June 1.

The institute was established last November as an instrument of the National Research Council and will have its headquarters at the NRC, 2101 Constitution Avenue, Washington 25, D. C. Its activities will be carried on in conjunction with those of the NRC's Division of Geology and Geography. The primary objectives of the new institute are the advancement of geology and its application to human welfare through the cooperation of organizations active in the fields of pure and applied geology. Membership is open to all nonprofit organizations concerned with the earth sciences.

The initial member organizations, whose memberships total more than 10,000, are: American Association of Petroleum Geologists, American Geophysical Union, American Institute of Mining and Metallurgical Engineers, Geological Society of America, Mineralogical Society of America, Paleontological Society, Seismological Society of America, Society of Economic Geologists, Society of Economic Paleontologists and Mineralogists, Society of Exploration Geophysicists, and Society of Vertebrate Paleontology.

Officers of the institute are A. I. Levorsen, dean of mineral sciences, Stanford University, president; W. B. Heroy, Beers and Heroy, Dallas, vice president; and Earl Ingerson, U. S. Geological Survey, Washington, D. C., secretary-treasurer.

Recently Received—

Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death: Sixth Revision of the International Lists of Diseases and Causes of Death; Adopted 1948. (Vol. 1.). Published by World Health Organization, 350 Fifth Avenue, New York 1, N. Y.

Tepexpan Man by Helmut de Terra, Javier Romero and T. D. Stewart. (Viking Fund Publications in Anthropology, No. 11.) (Illustrated.) Order from Viking Fund, 14 East 71st Street, New York 21, N. Y. $3.00.

Industrial Uses of Radioactive Materials: A Selected Bibliography. Available without charge from Arthur D. Little, Inc.; Cambridge 42, Mass.

Thomas Bartholin by Axel Garboe. (Acta Historica Scientiarum Naturalium et Medicinalium, Vol. V.) In Danish. Einar Munksgaard, Morregade 6, Copenhagen, Denmark. 21 kroner.

Utilization of Sucrose by the Mammalian Organism by Walter W. Wainio. (Scientific Report Series No. 12.) Copies obtainable from Sugar Research Foundation, Inc., 52 Wall Street, New York 5, N. Y.

Acids, Bases, and Non-Aqueous Systems by Ludwig F. Audrieth. (23rd Annual Priestley Lectures at Pennsylvania State College.) Issued by Phi Lambda Upsilon, Department of Chemistry, Pennsylvania State College, State College, Pa. $2.00.

Scientists: Supply and Demand (1), and Opportunities in the Medical Profession (2). Prepared by Western Personnel Institute, 30 N. Raymond Avenue, Pasadena 1, Calif. 50¢ and $1.00 respectively.

Make Plans for—

American Society for Agricultural Engineers, June 20–23, East Lansing, Michigan.

American Dairy Science Association, June 21–23, University of Minnesota, Minneapolis.

International Association for Dental Research, American Division, June 24–26, Chicago.

American Association of Dental Schools, June 27–29, Drake Hotel, Chicago.

American Society of Mechanical Engineers, June 27–30, San Francisco, California.

American Society for Testing Materials, June 27–July 1, Atlantic City, New Jersey.

American Home Economics Association, June 28–July 1, San Francisco, California.